National Aeronautics and Space Administration

Science with the Kepler Mission

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Mission Objective

Determine the frequency of earth-sized planets around solar-like stars.

Kepler is designed to take a census of planets around solar type stars in the galactic neighborhood of the Solar System. Kepler will detect earth-sized planets, and even smaller, with periods of 1 year or less.

Determine the characteristics of the planetary systems found.

Mission Description

Instrument: Photometer using 95cm aperture Schmidt camera
95 Mpixel CCD array, ~115 deg^2 field of view, 4 arcsec pixels

Detection method: Dimming of star brightness during planetary transit
20 ppm, 1 σ sensitivity for 6.5 hr transit of 12th magnitude G2V star (Earth transiting the Sun would be 80 ppm)

Orbit: Heliocentric, Earth trailing. Separates from Earth at ~0.1 AU/yr

Lifetime: nominal 3.5 years, extendable to ~6 years

Launch: February 2009

Science Capabilities

Normal operating mode: Stare at one field in Cygnus continuously for 3.5 years. Continuously record small groups of pixels around each of 170,000 target stars with 30 m integration time and 512 stars with 1m integration time. Break continuity for ~12 hr each month and ~24 hr each quarter for data downlink and spacecraft attitude changes. One minute cadence targets and guest observer targets may change monthly.

Planetary targets will generally be selected from F5 - M5 dwarfs in the magnitude range 9 to 16.

Expected exoplanet results from the Kepler Project.

A few hundred to a few thousand terrestrial planets
- Depends on the actual abundance of planets
- Get planetary size and distance from star from period and transit depth
- Measure masses of a few in short period orbits around low mass stars to get densities

200 - 600 transiting giant planets and some number of short period giant planets seen in reflected light
- Get planetary size and distance from star from period and transit depth
- Measure masses of a few. Get densities for transiting giants.
- Get albedos for transiting planets also seen in reflected light

Follow up stars with transiting planets with long term radial velocity monitoring to search for non-transiting planets in the system.

Asteroseismic studies of Kepler stars to determine stellar characteristics of age, mass and size.

Astrometric distances of many Kepler targets.

Some other possible science with Kepler

Study giant planet atmospheres with reflected light

Use transit timing measurements to search for non-transiting planets

Rotation rates of stars with detectable star spots

Study stellar surface features such as star spots and granulation

Look for stellar cycles similar to the Sun's solar cycle

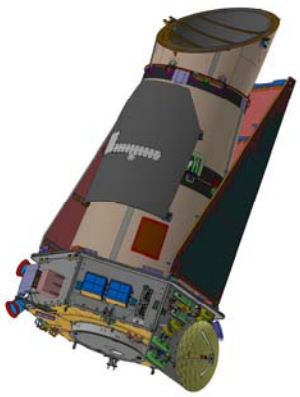
Eclipsing binary studies, including discovery of extreme mass ratio binaries

Investigate relationship of binarity to planet existence

Variability in external galaxies

Anything else enabled by precision long term photometry of objects in the Kepler field of view.

Background picture is the transit of Venus, 8 June 2004



Kepler is the 10th NASA Discover mission. Its development is managed by the Jet Propulsion Laboratory. During flight it will be managed and operated by the NASA Ames Research Center. Ball Aerospace and Technologies Corp. is the manufacturer and commercial partner of Kepler.

Opportunities for Participation

Participating Scientist Program
Eight proposals have been selected for scientists to work closely with the Kepler team to develop additional analysis methods for the Kepler data.
See http://nspires.nasaprs.com/external/
for details of the selected proposals

Guest Observer Program
Guest observers may propose to select targets in the Kepler field for collection of time series data.
3025 targets available at any one time
Changeable quarterly

Data Analysis Program
Community scientists may apply to engage in data mining of the Kepler data base of ~170,000 time series up to 3.5 years long.

More information at http://kepler.nasa.gov/

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